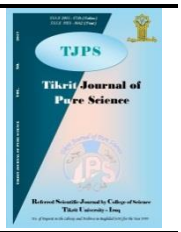
Tikrit Journal of Pure Science 23 (4) 2018

ISSN: 1813 – 1662 (Print)
E-ISSN: 2415 – 1726 (On Line)

TJPS

TIKRIT JOURNAL OF PURE SCIENCE

Journal Homepage: http://main.tu-jo.com/ojs/index.php/TJPS/index



Study of the water and suspended material quality in Tikrit university potable water plant / Iraq

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ARTICLE INFO.

Article history:

-Received: 21 / 12 / 2017

-Accepted: 24 / 1 / 2018

-Available online: / / 2018

Keywords: Qualitative Characteristics, Tikrit University, Standards.

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Abstract

Three stations were selected and collected (3) four water samples (Sedimentation basin, chemical treatment basin, filtration basin), including measurements of the physical and chemical characteristics of the water: pH, Electrical Connectivity (EC), Total Dissolved Solids (TDS), and Total Hardness (TH).

It included chemical analyses for the main components of water samples for cations such as: Sodium Na^{+}, Potassium K^{+}, Calcium Ca^{++}, and Magnesium Mg^{++}, and anions such as Chloride (Cl^{-}), Sulfate ($SO_4^{=}$), and Bicarbonates (HCO_3^{-}), and nitrate (NO_3^{-}) as minor component, and some trace elements such as Iron (Fe), Copper (Cu), Zinc (Zn), lead (Pb), Nickel (Ni), and Cadmium (Cd).

The chemical tests of sediment include measure the trace elements such as Cobalt (Co) Iron (Fe), Copper (Cu), Zinc (Zn), lead (Pb), Nickel (Ni), and Cadmium (Cd) and Chrome (Cr), also created the three sample for mineral test using X-ray diffraction in general company for geological survey and mining, where a representative sample of the main sample was taken (Normal) to determine the clay mineral, and then add ethylene glycol, heating 350 and heating 550, and calculate ratio of clay mineral in sediment sample by measure area under curve.

The results of physical and chemical analyses for the water samples after comparing them with standard specifications showed their validity there is an increase in concentration of some major Ions such as potassium and sulfates.

And the result of sediment test show increase in concentration of trace element(Co, Cu, Zn, Ni, Fe), that lead to increase in pollution of drink water, and the result of mineralogical study observed a metal clay (Chlorite, Montimorillonite, Illite, palygoriskite and kaolinite), the presence of clay mineral in the clay of filteration and sediment basins have negative side represented in difficult to remove these mineral from the basins and thus causing block the nomination of water.

Introduction

Drinking water is great importance for its close relationship with the public health aspects and the spread of diseases transmitted by it in the event of non-conformity with the standards specifications. The United Nations reports refer to use of contaminated water leads to the death one child every eight seconds approximately, So addition the reports referred to 50% of the population of developing countries suffer from diseases directly related to water and 80% of diseases are due to water pollution. Therefore, there was a need of Hydrochemical studies of water in addition to evaluating the work and efficiency of water treatment plants.

Hydrochemistry of water is of great importance in the process of assessing the quality of water sources, because the quality of this water is no less important than quantity.

In other words, chemical and physical specifications are essential for determining the validity of water for different uses [1].

The study area is located at the University of Tikrit, north of the Tikrit city, Salah al-Din, Water

purification project 20 meters away from the Tigris River.

The aims of this study is to evaluate the efficiency of the water purification project at the University of Tikrit, Saladin Governorate, physical tests and chemical analyzes and study of trace elements in the sediments, Standard for determining their potential for domestic use.

Describe the project stations

The Tikrit University Project is 20 meters away from the Tigris River. The project was established in 2001, and its area about 30m * 30m and design capacity 200m3 / hr. The project consists of five main units:

1- The first unit (intake): in this unit with drawl of water from river by pumps private type (low lift pump) and delivered it to sediment basin.

2- Second unit (sediments basin): this units contain tow basins inside the project, it was rectangular.

3- Third unit (chemical treatment): in this basin added the chlore and alum to purification water from the impurities, organic remains and microorganisms.

4- Forth unit (filter basin): there are two filter basins inside project in volume (100)m^3, use in these basin different filtration in size (layers of gravel and sand)

5- Fifth unit (assemblage basin): it's the final unit which is stores the water before pumped it to distribution net and then to campus, Figure (1), shown sketch at illustration main project units.

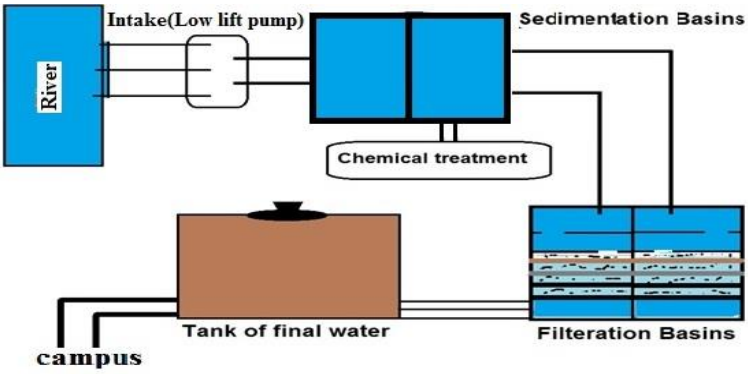


Figure (1), shown sketch at illustration main project units

Work Method

Water samples were collected from three units: primary sedimentation, chemical treatment, and filtrations basin (picture1). And Physicochemical tests(pH, EC, TDS, TH) were measured, and the chemical analyses cations (Na, Ca, K, and Mg), measured by, (Atomic adsorption spectrophotometer) by (FAA) (Flame Atomic Adsorption) which infer it by ablution which depended on flame technique, and the flame type used in this technique (flame air – acetylene C_2H_2), the measurement were made after diluting the sample 100 times with ionic water so that the ion concentrations within the range of the device.

And anions (SO_4, NO_3, and PO_4) measured by (Ultraviolet spectra photo meter) and HCO_3 tested by volumetric method.

Also the trace elements (Co, Pb, Cu, Zn, Ni, Cr, Cd, Fe) were calculated by (Atomic adsorption spectrophotometer) and compare it with specification standard [2,3] (WHO, and IRS), these analyzes were measured in analytical chemistry laboratories in the Department of Chemical Engineering/ University of Tikrit.

The study of the sediments of the three units (sedimentation basin, chemical treatment, and filtrations basin) in the project was also studied, and the trace elements in the sediments were calculated by Atomic adsorption spectrophotometer, also created the three sample for mineral test using X-ray diffraction in general company for geological survey and mining.

Picture 1, shown the sampling from the project

Result & Discussion

Water analysis :

A: Physiochemical measurement

The result of tests are Explained in table (2).

1- pH

values ranged between (7.88- 7.91) which are within the limits allowed within the Iraqi specifications (6.5-8.5) and (WHO) (6.5- 9.2).

2- Total Dissolved Solid (TDS)

values of (TDS) ranged between (294-325) which are within the limits allowed within the Iraqi specifications (1500 mg/l) and (WHO) (500 mg/l).

3- Electrical Conductivity (EC)

values of (EC) ranged between (487-503ms/cm) which are within the limits allowed within the Iraqi borders and (WHO).

4- Total Hardness (T.H)

values of (TH) ranged between (18.54- 34.46 mg/L) which are within the limits allowed within the Iraqi specifications and (WHO) (500mg/L), that considered Soft water as explained in table (1).

Table (1) show classification of water depending on values of total hardness

Total hardness	Water Class
0-75	Soft
75-150	Moderately Hard
150-300	Hard
300>	Very Hard

B :Chemical analyses for Samples Water:

Chemical analysis of water has been conducted on inorganic components that include major, and minor ions and heavy elements.

1- Major ions:

Its include find Concentration and roots of major ions values of water within methods and specialized devices for this purpose, to determine this ions concentrations follow regular and analytical methods as in describe in many references [4].

The common major ions that controlling in chemical properties of water (Mg^{+2}, Ca^{+2},Na^{+}, K^{+}) as a cations and (SO_4^{-2} ,Cl^{-} , HCO_3^{-}) as an anions .

a- Major cataions (Na^{+}, Ca^{+2}, Mg^{+2}&K^{+})

The analysis result was as shown in table (2), were calcium concentration ranged between (7.4-8.2 mg/l), and its much lower than the limit allowed in the specification of Iraq (200 mg /L) and (WHO) (100 mg/L).

As for magnesium concentrations were in the filtration basin sample (> 0.01), and in the sediment and treatment basin (2.43, 3.65 mg /L) respectively, and its less than the limit allowed in the specification of Iraq (150 mg /L) and (WHO) (50 mg/L).

Registered sodium concentration between (6.667-11.167 mg/ L), their values are remarkably lower than limit allowed in the specification of Iraq and (WHO) (200 mg/L). potassium concentration range between (195.045- 208.24 mg/L), exceeded the limit allowed in the specification of Iraq (10 mg/L) and (WHO) (12 mg/L).

b- Major and Minor anaions (NO_3=, $PO_4^{=}$, Cl-, $SO_4^{=}$, HCO_3^{-})

Ions concentration varied in basins water were as nitrate concentration between (0- 8.8 mg/L), did not exceed the limit allowed in the specification of Iraq and (WHO) (50 mg/L), and phosphate ions range between (0.01 -0.138 mg/L) did not exceeded limit allowed in (WHO) (0.4 mg/ L).

And chloride concentration range between (349.9-499.85 mg/L) it exceeded the limit allowed in the specification of Iraq (350 mg/L) and (WHO) (250 mg/L).

Concentrations of sulfates range between (0- 327.08 mg/L), its exceeded in sediment basins the limit allowed in the specification of Iraq and (WHO) (250 mg/L). The bicarbonates concentrations are ranged between(79.3- 97.6 mg/L), its located within the limit allowed in the specification of Iraq and (WHO) (125-

350 mg/L), and table (2) explained the results of physical and chemical analysis of water.

Table (2) explained the results of physical and chemical analysis of water.

No.	pH	TDS	EC	T.H	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$NO_3^{=}$	Cl^{-}	$PO_4^{=}$	$SO_4^{=}$	HCO_3^{-}
Intake	7.91	325	503	34.47	7.8	3.65	6.667	203.84	Nil	399.87	0.138	327.08	79.3
Tu/Filter in put	7.88	299	487	30.46	8.2	2.43	11.17	195.05	8.8	499.84	0.098	Nil	94.6
Tu/Filter out put	7.92	294	492	18.54	7.4	Nil	8.167	208.24	2.2	349.89	0.01	Nil	97.6

C : Heavy elemnts

This group include many elements, but it was measure the following items (Ni, Cd, Pb, Zn, Fe, Cu), measured in the same method and device which of major cataions. The result were compared with a similar study for the same project and the values were within the specifications [2] and [3].

Sediments testing

A: Trace elements

The environment's pollution in heavy metallic elements is global problem caused this elements non-perishable, it has the effect of intoxicated on organisms, and for this elements high environmental importance because don't move from water during the filter process but it was gather lies in the cover of water and then in the food series [5].

Is the importance of study these elements to find out pollution of human events such as industrial and agricultural activities and discharge, as some of elements be harmful and some are to be necessary for life [6], within certain concentration.

And study heavy elements in the clay part of samples as shown in table (3), the explanation of results that given from the analysis of trace elements concentrations depended on comparing between it and recorded concentration of natural abundance for these elements in the earth crust or in the sediments [7], [8] and [9].

Has been studying more elements common in the nature and more effect on the humans, it is follows:

1- Cobalt (Co):

The high concentration of cobalt in the earth crust comes from basal igneous rocks it reach to (200 mg/L), the geological cycle of cobalt similar to iron and manganese cycle and may be tend to link in minerals of those elements, so the cobalt disposal in te sediments affected by presence of manganese oxides because it high susceptibility to the absorbed [10], the cobalt values in the samples were (50>), it exceeded the concentration allowed for presence of the element in the sediments as [9], as shown in the table (3).

2- Lead Pb:

The lead presence in the environments were two types primary or secondary, primary is made with the composition of minerals, and secondary origin was from the radioactive elements as uranium, lead tends to link with sulfates and oxygen as a result to this link form galena (PbS) and seresite ($PbCO_3$) [11], the element concentrations were less than (3 mg/L), its less than concentration allowed as [9], as shown in the table (3).

3- Copper (Cu)

Copper appear in the earth crust in concentration between (25-75 mg/L) in average (55 mg/L), the abundance pattern of copper in the rocks is appear tend to focus in the basal igneous rocks in the sediments of kind (Argillaceous)**,** the regularity in large – scale copper appearance in the soil indicates two major factors origin material and soil formation process that control of initial copper state within the soil [10], copper values were ranged between (27- 38 mg/L) the background of the element has been exceeded in the sediments as shown in table(3).

4- Zinc (Zn)

The average earth crust of zinc is estimated to be 70 mg/kg and the same for the world. Concentrations of zinc in igneous rocks but in sedimentary rocks tends to focus in type of sediment (Argillaceous), it is highly move during weathering and its compounds are easy to dissolve and precipitate rapidly when interacting with carbonates, or absorbed by the metals and organic components [10], and the concentration allowed is (300 mg/L) as [9].

This concentration elements is low in the earth crust this is due to mineral nature which are characterized by their low solubility which control by pH of water[12], values of zinc ranged in samples between (70-133 mg/L), it has been exceeded in the sediments as shown in table(3).

5- Nickel (Ni)

Nickel movement was affected with abundant organic metal and an extend of pollution soil [13], concentration ranged (153-196 mg/L) its high rate for allowed in the sediments as shown in table(3).

6- Chrome (Cr)

The important sources of this element is chromite, tourmaline chrome, garnet chrome, mica chrome, phosphates fertilizers and burning products [14], chrome values was (129- 167 mg/L), it has been exceeded in the sediments as shown in table(3).

7- Cadmium (Cd)

Cadmium is be found in lead and galena ores [15], Cadmium similar to zinc from geochemically but they have difference from the nature abundance [3], Cadmium values was low than (10 mg/L) its low rate and locate within background element concentration in sediments allow it as shown in table(3).

8- Iron (Fe)

Iron found in many metals like as pyroxene, amphibole, biotite, magnetite, olivine and barite, iron solubility under the weather conditions mainly controlled by pH, iron concentration was very low in surface water [12], iron values range between (2.8-3.5%) its exceed the limit allow it in the sediments as [9] as shown in table(3).

The receive increase in some elements concentrations (cobalt, copper, chrome, iron) according to allow concentrations of these elements as [9] due to domestic, agricultural, oil and other activates carried out by man, whose throw its ruins in Tigris river, in addition existence waste and craps on the Tigris river bank which is the main cause of increased pollutant and elements concentrations increased which a toxic effect in human life and living organism.

Table (3) show the analysis results of trace and major elements in(mg/L)

Sample	Co	Pb	Cu	Zn	Ni	Cr	Cd	Fe %
Filter	<50	<3	27	70	153	129	<10	2.8
Chlorine	<50	13	38	133	182	167	<10	3.64
Irrigation	<50	<3	34	108	196	157	<10	3.29
Moon et al, 2006	10	15	15	35	17	45	100 ppm	0
Rose et al, 1987	10	17	15	36	17	43	0.5-0.1	21000

B: X-Ray Diffraction test:

The diagnosis of main clay mineral which appeared in XRD in normal sample, and the result appear all the sample contain the same mineral content as shown in the figure (2).

The percentage rate of mineral was calculated by (Area under curve), away that the semi- quantitative as [17]. Depending on the thickness of the mineral layer, which is the adjective fixed for each mineral, rates of clay minerals presence in samples shown in table (4).

Clay Minerals:

a- Chlorite & Montimorillonite

Chlorite is acommon metal in the soil is composed of filtering moderate groundwater acidic and in the areas of dry climate[18], its result from weathering the original igneous rocks and metamorphic rocks that contain high rates of magnesium, iron and calcium elements[19]. Montimorilonite formed from weathering the basal and mafic rocks that are rich in magnesium [20], rate of chlorite and montimorillonite in filter sample was (43.22), in chlorine sample chlorite and montimorillonite rate of was (31.34), in irrigation sample chlorite and montimorillonite was (31).

b- Palygorskite

Is a fiberic metal made up either of the sedimentation chemical as minerals that formed in lagoon environments and evaporates basins or as for from clay shapes in the early diageneous stages in continental environments and internal lakes and sea [21], palygorskite rate in filter sample was (9.63) chlorine sample was (15.07), in irrigation was (12.86).

c- Illite

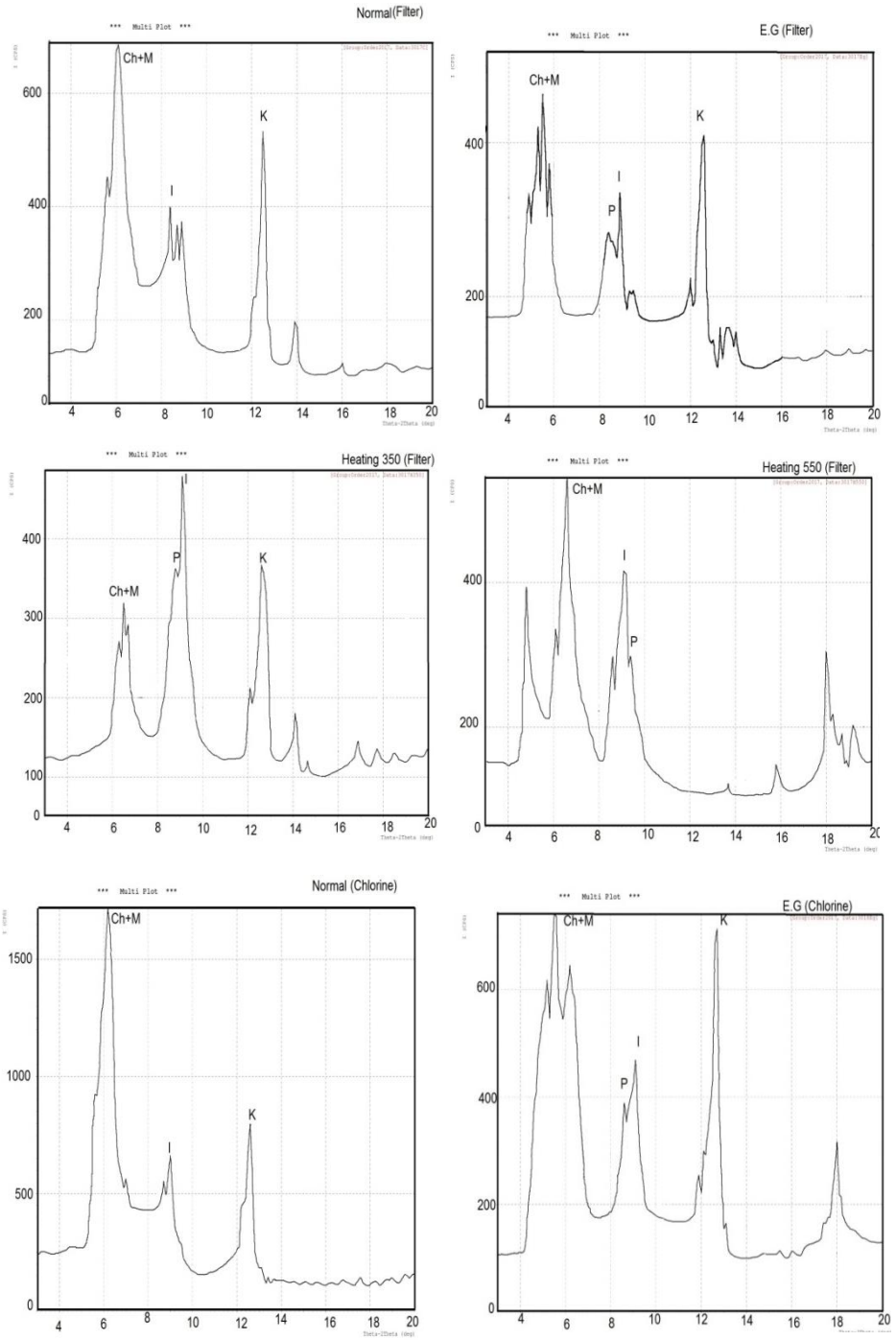
Is derived from weathering of igneous rocks that rich in alkali feldspare as andesite and rhyolite that presence in rock group volcanic ash [22]. And derived from Reworking sedimentary rocks [23], Illite rate in filter sample was (9.63), in chlorine sample was (15.07), in irrigation was (12.86).

d- Kaolinite

This metal derived from igneous rocks that contain potassium feldspare [17]. kaolinite rate in filter sample was (11.8), in chlorine sample was (25.42), in irrigation was (27).

the presence of clay mineral in the clay of filteration and sediment basins have negative side represented in difficult to remove these mineral from the basins and thus causing block the nomination of water especially mineral of type 1:1, such as kaolin which is the hardest movement of mineral of typy 2:1 extended and an extended as (palygorskite), duo to the roughness mineral of the first type [16].

ISSN: 1813 – 1662 (Print)
E-ISSN: 2415 – 1726 (On Line)



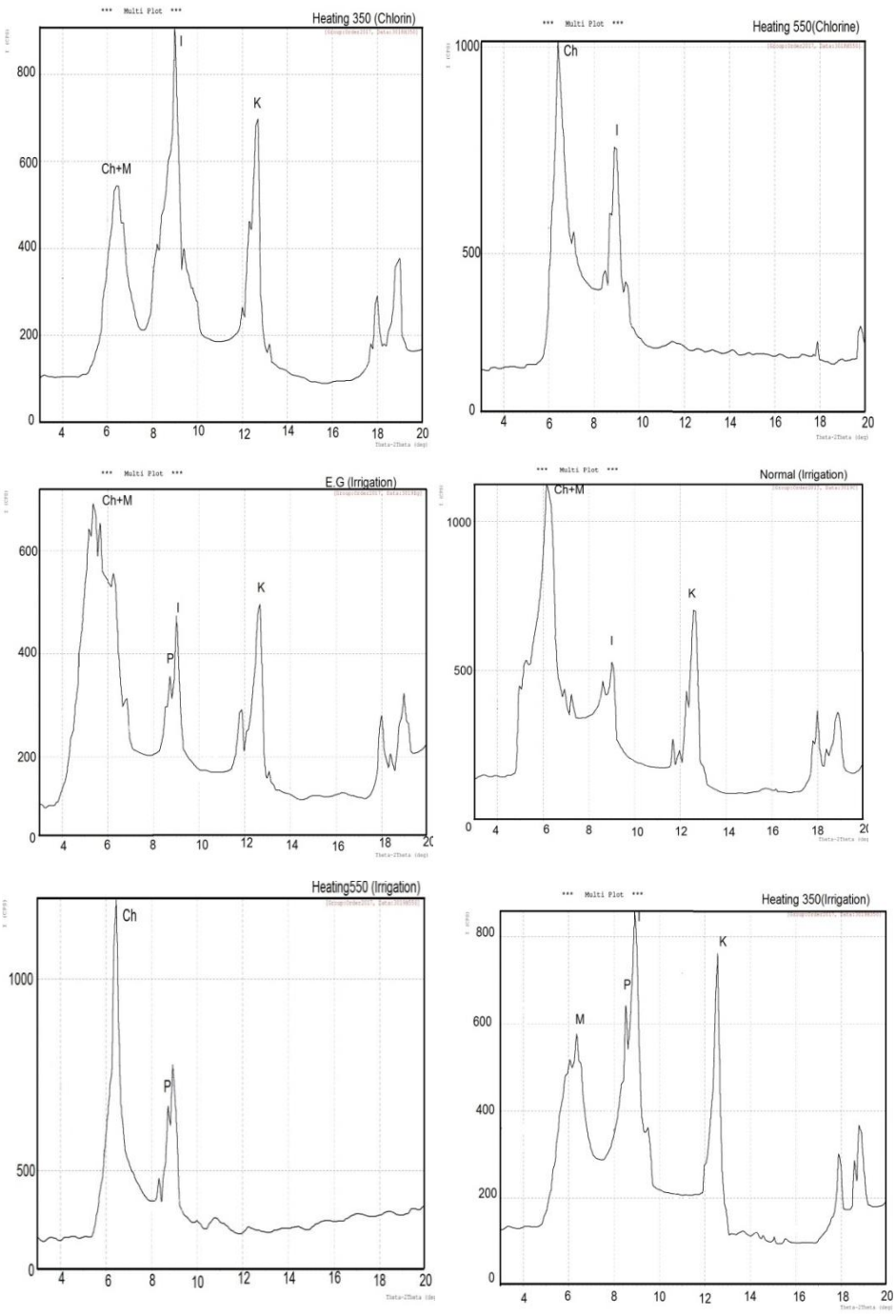


Figure (2) Result of XRD analysis for sediment sample

Table (4)ratio presence of main mineral in sediments of project basins

Sample	Ratio %				
	Chlorite	Montimorillonite	Palygorskite	Illite	Kaolinite
Filter 1	43.22	43.22	9.63	9.63	11.8
Chlorine 2	31.342	31.342	15.07	15.07	25.42
Irrigation3	31	31	12.86	12.86	27

Conclusion

After the analysis results of this study, reach for many conclusions which can be listed as follow:

1- The minimum and higher values range for pH between (7.88-7.91), and results of (TDS) between (294-325), (EC) values was between (487-503), as for (TH) between (34.46-18.54), all these located within limit allowed in the specification of Iraq and (WHO).

2- Concentrations of major and manor catainos and anaions don't exceeded the limit allowed in the specification of Iraq and (WHO), except potassium which its values very high as well as sulfates values exceeded the allowed limited in the sediment basin.

3- Trace elements in water don't exceed the limits allowed in the specification of Iraq and (WHO) .

4- Some trace elements in the sediment exceeded allowed limits according to its presence in sediments as (cobalt, copper, zinc, nickel and iron), and (lead, chrome and cadmium) stay in the allow limits.
5- The diagnosis of clay minerals of samples appear the following (chlorite, montimorillonite, palygorskite, Illite and Kaolinite) in different ratio.

Recommendation

1- There should be continuous monitoring of all water project to regularly analyze water, to ensure the preservation in order for drinking water in limit allowed in the specification of Iraq and (WHO)
2- Sediments basin analysis within projects to reduce the impact on water, in addition the sediments effects on these projects work.

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Tikrit Journal of Pure Science 23 (4) 2018 *ISSN: 1813 – 1662 (Print)*
E-ISSN: 2415 – 1726 (On Line)

دراسة نوعية للمياه والمواد العالقة لمشروع اسالة جامعة تكريت / العراق

اكتفاء طه عبد القادر

قسم علوم الارض التطبيقية ، كية العلوم ، جامعة تكريت ، تكريت ، العراق

الملخص

تم جمع ثلاث نماذج من مشروع اسالة ماء الجامعة (الماء الخام(نهر دجلة)، وحدة المعالجة، وحدة الترشيح)، وتم قياس الصفات الفيزيائية والكيميائية لنماذج المياه، والمتمثلة الرقم الهيدروجينيpH، والتوصيلية الكهربائية (EC)، والمواد الصلبة الكلية المذابة (TDS)، فضلا عن حساب العسرة الكلية (TH).

كما تضمن إجراء التحليلات الكيميائية للمكونات الرئيسة للنماذج المائية، والمتمثلة بالأيونات الموجبة Cations))، وتشمل أيونات الصوديوم (Na+)، البوتاسيومK+))، الكالسيوم (Ca++)، والمغنيسيوم Mg++))، وكذلك الأيونات السالبة Anions))، وتشمل الكلورايد(Cl−)، الكبريتات (SO4=)، والبيكاربونات (HCO3−)، والمكونات الثانوية مثل النترات (NO3−)، وبعض العناصر الثقيلة أو النزرة، مثل الحديد (Fe)، النحاس (Cu)، الخارصين (Zn)، الرصاص (Pb)، النيكل (Ni)، والكادميوم (Cd).

وتم اجراء الفحوصات الكيميائية للرسوبيات وتضمنت قياس تراكيز العناصر النزرة فيها مثل الكوبلت (Co)، الحديد (Fe)، النحاس (Cu)، الخارصين (Zn)، الرصاص (Pb)، النيكل (Ni)، والكادميوم (Cd)، الكروم (Cr)، كذلك اجريت الفحوصات المعدنية لنماذج الرسوبيات الثلاثة باستخدام حيود الاشعة السينية في هيئة المسح الجيولوجي العراقية، حيث اخذ النموذج المتمثل بالحالة الطبيعية للنموذج وحدد فيه المعادن الطينية وبعد ذلك تم اضافة الاثلين كلايكول، وبعدها حددت المعادن بدرجة حرارة 350 و 550 درجة، وحسبت نسب تواجد المعادن الطينية في النماذج باستخدام طريقة حساب المساحة تحت المنحني.

اظهرت نتائج الفحوصات الفيزيائية والتحليلات الكيميائية للنماذج المائية بعد مقارنتها مع المواصفات القياسية، ملاحظة زيادة في تراكيز بعض الايونات الرئيسية مثل البوتاسيوم والكبريتات.

كما اظهرت نتائج فحوصات الرسوبيات بعد مقارنتها مع (Moon,2006,)& (Rose, 1987)، وجود زيادة في بعض العناصر النزرة في رسوبيات الاحواض (الكوبلت، النحاس، الخارصين، النيكل، الحديد) التي من شأنها زيادة التلوث في مياه الشرب، واظهرت نتائج الدراسة المعدنية وجود المعادن الطينية التالية في نماذج الرسوبيات (الكلورايت، المونتمورلونايت، الالايت، الباليكورسكايت، الكاؤلينايت)، ان تواجد المعادن الطينية في مرشحات واحواض الترسيب له تأثيرات سلبية على عمل المشروع وتتمثل في صعوبة تحرك هذه المعادن من الاحواض وبالتالي تعيق حركة المياه فيها.

الكلمات المفتاحية: الخواص النوعية، جامعة تكريت، المواصفات القياسية.